



## Commercial Opportunity

### Novel Activated Carbon For Hydrogen Cyanide

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#### THE CHALLENGE

There is an ongoing requirement to provide enhanced protection against a range of chemical and biological warfare agents, as well as more common toxic industrial chemicals, without increasing the physiological burden on a respirator user. This requires the development of new adsorbent media that have improved removal efficiencies and capacities in order to allow reduced filter bed quantities and hence lower overall respiratory burden.

Removal of toxic substances, more especially hydrogen cyanide, from air goes beyond military applications and has relevance in fields as diverse as the filtration of tobacco smoke to the manufacturing of cyanide based chemicals e.g. nylon and acrylates. In addition, there are also the more obvious applications in the civilian emergency response / industrial protection equipment sectors.

#### THE DSTL INNOVATION

The UK MoD's Defence Science & Technology Laboratory (Dstl) has developed a novel activated carbon production process for filters aimed at the catalytic removal of toxic substances (in particular hydrogen cyanide and cyanogen gas) from air, for example in a breathing apparatus. Activated carbon containing at least one embedded transition metal (e.g. copper, silver, cobalt or chromium) is produced by exchanging the metal with the sodium salt of a carboxymethyl cellulose based ion exchange material (which can be derived from paper or cardboard). This is then followed by activation using a simple thermal cycling process which, importantly, can independently vary the meso-to-micro pore ratio and hence the specific adsorption characteristics of the material. The technology has been researched and developed up to a proven to a lab scale concept level.

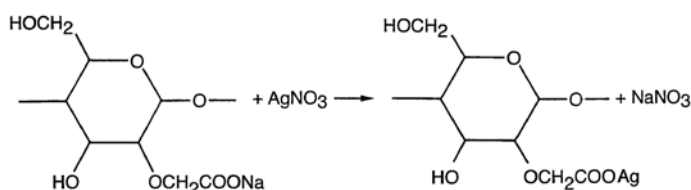


Figure 1 - Illustrating the ion exchange process of the carboxymethyl cellulose based material with silver.

Compared to conventional impregnated activated carbons, the invention has the following features and benefits:

- Better dispersion of metal catalyst (less aggregation, better utilisation, reduced costs)
- Reduced mobility of metals (less ageing, better shelf & operational life)
- Works well with scrap paper as feed stock (relatively low yields but green)
- Excellent performance on difficult to remove toxic gases (reduced bed quantities and burden)
- Effective with a variety transition metals (Co, Cu, Ag, Cr) - singly or in combinations (flexibility)
- Independent control of meso:micro pore ratio (tailor to specific contaminant)

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Potential applications include:

- Air purification – personal respirators, collective protection filters, waste gas scrubbers
- Industrial - precious metal catalyst carrier in pharma, petro and agro-chem applications  
e.g. catalytic decomposition of hydrogen cyanide waste in chemical manufacturing of adiponitrile, nylon and poly methylmethacrylate etc
- Commercial – specialty cigarette filters for removal of toxic and noxious gases from tobacco smoke

## THE OPPORTUNITY

The markets for impregnated activated carbons are many and varied, ranging from bulk use as an absorbent in water treatment and air filtration/scrubbing, to more specialist use as a decolourant or catalyst carrier in food, petrochemical and pharmaceutical production. The Dstl technology is directed at more focussed high performance applications that require the removal of toxic compounds, particularly as hydrogen cyanide, for health or safety reasons. Whilst these markets are niche in terms of overall activated carbon sales, they are still quite sizable and attractive opportunities. For instance, the market for CBRN respirator media is estimated to be in the region £50-100m pa and the market for special cigarette filter media is estimated to be in the region £25-50m pa.

Dstl has undertaken an extensive programme of research in connection with the cellulose based activated carbon technology for which it owns the IP rights. These IP rights comprise a published PCT patent application (WO 1999/11358) and know-how in the form of formulations and test results as embodied in a number of technical reports and sample materials.

The patent claims a method of manufacture of an activated carbon filter containing embedded transition metals (via ion exchange with cellulose derived material), a filter and a method of filtering gaseous contaminants. The patent has granted in the USA and the major European countries but is still pending in Japan.

Ploughshare Innovations, the technology transfer company of Dstl, is actively seeking suitable licensees to commercially exploit the patented technology in commercial and industrial markets.